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**Summary:**

This document describes the calculation procedure of surface tilt angles of Ryugu for Watanabe et al. (2019).

**Description:**

The surface tilt angle was defined as the angle between rotation axis and outline of a shape model. It was calculated from a polygon information list SHAPE\_SFM\_3M\_v20180804.csv. The csv file contains position of each facet. From the csv file, outline of the shape model with 0.1˚ thickness in longitude was extracted. For latitude ranges 15±10˚ and 35±10˚, the surface tilt angles were calculated by fitting outlines by linear regressions.

**Available files:**

This document covers an input file and a R script.

* SHAPE\_SFM\_3M\_v20180804.csv – polygon information list
* WS2019\_SM\_tilt.R – R script

**Procedure:**

1. Specify input file path in a R script “WS2019\_SM\_tilt.R”, then issue the script to calculate outlines.